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IFW AF/2878

PATENT APPLICATION

ATTORNEY DOCKET NO. 10991682-1

123

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Sorin et al.

Serial No.: 09/488,149 **Examiner:** Wang, George

Filing Date: 01/20/2000 **Group Art Unit:** 2878

Title: SYSTEM AND METHOD FOR OPTICAL HETERODYNE DETECTION OF AN OPTICAL SIGNAL THAT UTILIZES OPTICAL ATTENUATION

COMMISSIONER FOR PATENTS
PO Box 1450
Alexandria, VA 22313-1450

TRANSMITTAL OF REPLY BRIEF

Sir:

Transmitted herewith in ***triplicate*** is the Reply Brief with respect to the Examiner's Answer mailed on **03/05/2004**. This Reply Brief is being filed pursuant to 37 CFR 1.193(b) within two months of the date of the Examiner's Answer.

(Note: Extensions of time are not allowed under 37 CFR 1.136(a))

(Note: Failure to file a Reply Brief will result in dismissal of the Appeal as to the claims made subject to an expressly stated new grounds of rejection.)

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Typed Name: **Mark A. Wilson**
Signature: Mark A. Wilson

Respectfully submitted,

Sorin et al.

By Mark A. Wilson

Mark A. Wilson
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Date: **05/05/2004**

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Attorney Docket No. 10991682-1 PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Appellant: Sorin et al.
Serial No. 09/488,149
Filed: January 20, 2000
For: SYSTEM AND METHOD FOR OPTICAL HETERODYNE DETECTION OF AN OPTICAL SIGNAL THAT UTILIZES OPTICAL ATTENUATION

Group Art Unit: 2878
Examiner: Wang, George

Assistant Commissioner for Patents
Washington, D.C. 20231

REPLY BRIEF

Sir:

This Reply Brief is filed in response to the Examiner' Answer dated March 5, 2004 and in furtherance of Applicants' appeal of the decision of the Examiner dated August 26, 2003 finally rejecting claims 1 – 20. This Reply Brief is transmitted in triplicate.

CERTIFICATE OF MAILING UNDER 37 C.F.R. 1.8

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Date: May 5, 2004 Signed: Mark A. Wilson

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REPLY BRIEF

The Examiner's Answer to the Appeal Brief states that the Appellant has misinterpreted the text of Introduction to Communication Systems and specifically example 4.4.6 in support of the contention that placing an attenuator at the input chain of optical components is detrimental when signal-to-noise ratio is important. Specifically, the Examiner states:

> "From the text, we see that F does not represent noise, but rather, the *noise figure*. The noise figure is associated with amplification noise (see Eq. 4.66) and not output noise, N_o, which we are interested in. As such, the formula does not apply. The equation that does apply is the formula that shows the relationship between N_o and α and this is denoted in Equ. 4.65, where the relationship between N_o and α is the inverse relationship:
>
> $$N_o = 1/\alpha$$
>
> Here, we clearly see that when attenuation, α, increases, noise, N_o, decreases."

In response, Applicants assert that the reference has not been misinterpreted. Based on the Examiner's logic, the Examiner is asserting that reducing the noise, N, in a system necessarily reduces the signal-to-noise ratio. This is incorrect because the signal-to-noise ratio is a function of the ratio of the signal to the noise not just the magnitude of the noise. Consider two electrical spectrum measurements that include a signal component and a noise component. For example, Figs. 1A and 1B depict two electrical spectrum measurements that include a signal component and a noise component. When comparing the two measurements, the absolute noise level depicted in Fig. 1B is lower than the absolute noise level depicted in Fig. 1A. However, even though the absolute noise level in Fig. 1B is lower than the absolute noise level in Fig. 1A, the signal-to-noise ratio of the measurement of Fig. 1A is higher than the signal-to-noise ratio of the measurement of Fig. 1B because the signal-to-noise ratio depends on the magnitude of the signal and the magnitude of the noise not just the magnitude of the noise alone. Using the logic provided in the Examiner's Answer, the measurement of Fig. 1B would provide a better signal-to-noise ratio than the measurement of Fig. 1A simply because the noise component is lower.

When signal-to-noise ratio is the measurement of concern as is the case in the Applicants' argument, a comparison of system performance with and without an attenuator must be looked at in terms of the measured signal-to-noise ratio with an attenuator versus the measured signal-to-noise ratio without an attenuator. The comparison of two signal-to-noise ratios is by definition the noise figure (see Eq. 4.62 of Appendix A from Appeal Brief). As defined, the noise figure describes the signal-to-noise ratio improvement or degradation between two signal-to-noise measurements and thus it is relevant to Applicants' arguments.

Further, consider an electrical system with an attenuator and an electrical spectrum analyzer as depicted in Fig. 2. Looking at this system as a whole, the measured signal-to-noise ratio (SNR_{meas}) is expressed as:

$$SNR_{meas} = SNR_{in}/F_{net}$$

where SNR_{in} is the input signal-to-noise ratio and F_{net} is the net noise figure of the system. The net noise figure F_{net} can be expressed as:

$$F_{net} = F_1 + (F_2 - 1)/G_1 = \alpha + (F_2 - 1)/(1/\alpha)$$
$$F_{net} = \alpha + (F_2 - 1)\,\alpha = \alpha(1 + F_2 - 1)$$

such that,

$$F_{net} = \alpha F_2$$

where G_1, is the power gain and α is the attenuation. As shown, the net noise figure, F_{net}, is directly proportional to the attenuation, α, and therefore, increasing the attenuation increases the net noise figure, F_{net}. Because $SNR_{meas} = SNR_{in}/F_{net}$, any increase in the net noise figure, F_{net}, (e.g., from increased attenuation) degrades the signal-to-noise ratio of the output measurement, SNR_{meas}.

Therefore, it is clear that increasing the attenuation of an electrical system will degrade the signal-to-noise ratio and there is not a motivation to increase attenuation as put forth by the Examiner. In contrast, the degraded signal-to-noise ratio that results from increased attenuation in a system such as that of Fig. 2 teaches away from applying attenuation when signal-to-noise ratio is important.

Now consider an optical system that includes an optical spectrum analyzer and attenuator as depicted in Fig. 3, where the optical spectrum analyzer uses a diffraction grating as a tunable filter. In this system, the noise is dominated by electronics noise (e.g., thermal noise) which is independent of the input signal and therefore attenuating the input signal does little to reduce the noise while substantially reducing the signal power. As described above with reference to Figs. 1A and 1B, reducing the signal power without a proportional reduction in the noise degrades the signal-to-noise ratio. Fig. 4 depicts an example graph of measured electrical spectrum, P_s, versus optical frequency, υ, produced with the system of Fig. 3 when there is no attenuation (e.g., $\alpha = 0$) and when there is some significant attenuation (e.g., $\alpha = A$). Because the noise is dominated by electronics noise, as depicted in Fig. 4, only the signal level is reduced by the attenuation. Because only the signal level is reduced by the attenuation, the attenuation causes the signal-to-noise ratio to be degraded.

From the above examples, it is clear that adding an attenuator to an electrical or optical spectrum analyzer typically reduces the signal-to-noise ratio. It is not until the relationships between I_N, I_H, and P_S that exist in a heterodyne detection system are recognized (see disclosure and Appeal Brief) that attenuation becomes a viable option for improving the signal-to-noise ratio.

In view of the above-provided remarks, it is clear that the above-cited reference has not been misrepresented. Further, neither the cited prior art nor the Examiner's Answer provide the teaching or suggestion that is required to support an obviousness rejection in this case.

On page 7, the Examiner's Answer responds to an additional argument put forth in the Appeal Brief by stating that "[t]his decrease is representative of the a relationship that is consistent with the circuit taught by Evans." In response, Applicants note that Evans uses an attenuator to reduce harmonic distortions. Although the addition of an attenuator is used to reduce harmonic distortions, as described above and as is well known in the art, <u>the noise figure of the amplifier in Evans will increase with increased attenuation</u>. Therefore, it is improper to rely on Evans as the basis for the motivation behind the combination of references that is suggested by the Examiner.

Critical argument not addressed by Examiner's Answer

Applicants point out that the Examiner's Answer has neglected to address a critical argument put forth in the Appeal Brief. Specifically, the Examiner's Answer has not addressed the argument beginning on page 9 of the Appeal Brief that the proposed modification to Sorin would render the teachings of Sorin unsatisfactory for their intended purpose. A proposed modification that would render a reference unsatisfactory for its intended purpose provides strong evidence that the claimed invention is not rendered obvious in view of the cited prior art.

Claims 4 and 12 not addressed

Further, Applicants point out that the arguments related to claims 4 and 12 were not addressed in the Examiner's Answer. These claims are allowable over the cited prior art.

SUMMARY

Because there is no suggestion or motivation in the AAPA, Sorin, Hasegawa, or Evans or in the knowledge generally available to one of ordinary skill in the art to modify the AAPA and Sorin to include the teachings of Hasegawa and Evans and because Sorin would not work for its intended purpose if modified as suggest by the Examiner, a case of obviousness has not been made and claims 1, 11, and 14 are not rendered obvious from Sorin in view of Iwaoka.

For all the foregoing reasons, it is earnestly and respectfully requested that the Board of Patent Appeals and Interferences reverse the rejections of the Examiner regarding claims 1 – 20, so that this case may be allowed and pass to issue in a timely manner.

Respectfully submitted,

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Date: May 5, 2004

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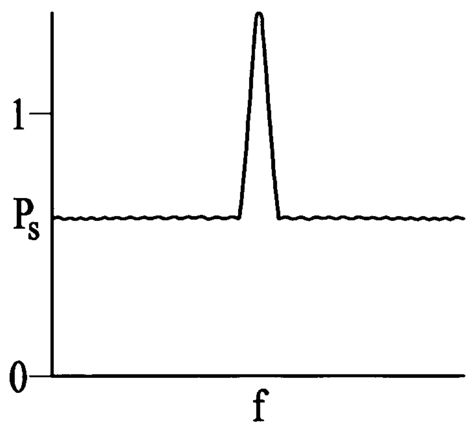

FIG.1A

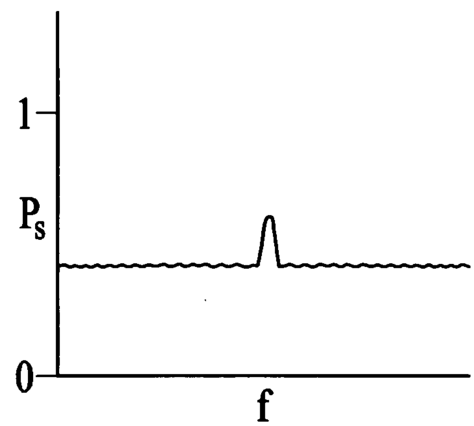

FIG.1B

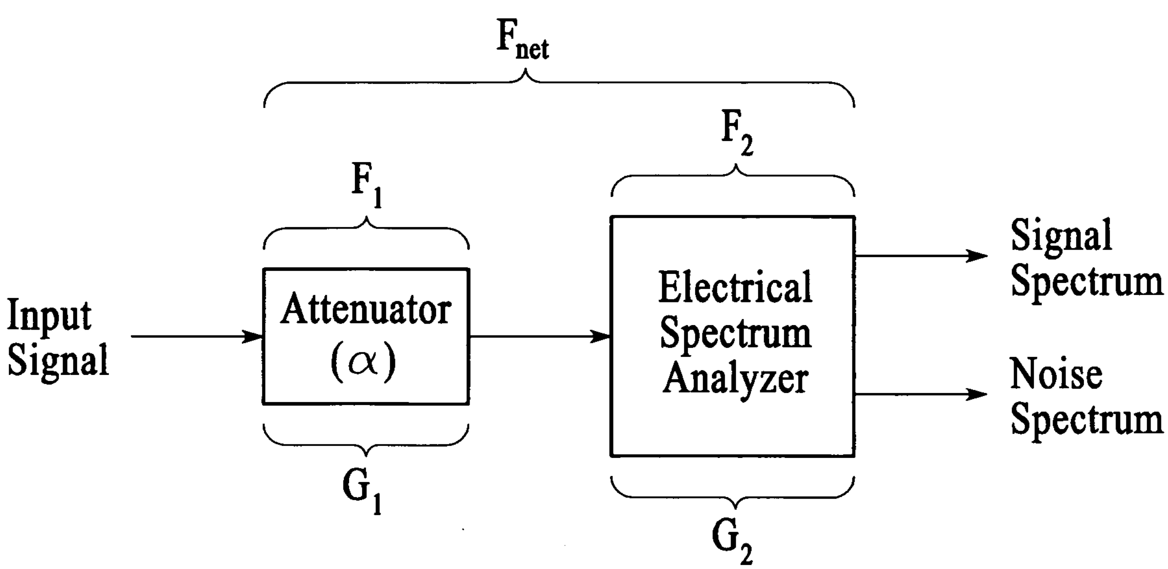

FIG.2

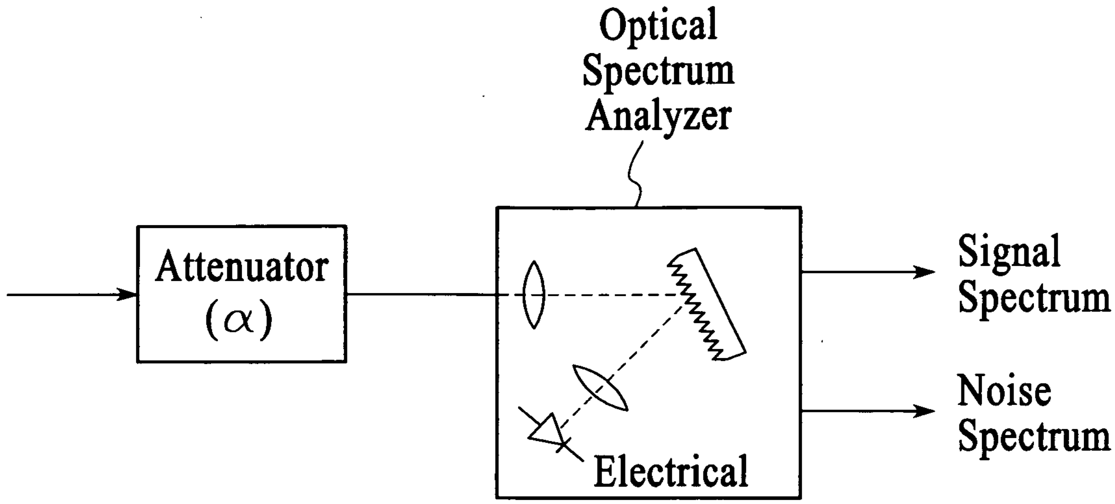
Optical
Spectrum
Analyzer
Attenuator
(α)
Signal
Spectrum
Noise
Spectrum
Electrical

FIG.3

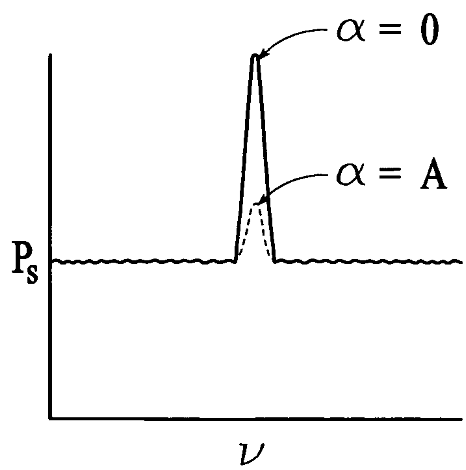
α = 0
α = A
P_s
ν

FIG.4